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TITLE:	METHOD FOR ALTERING DESIGN DATA FOR PRODUCING A COMPONENT, AND ASSOCIATED UNITS
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Method for altering design data for producing a
component, and associated units

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The invention relates to a method in which design data
are prescribed which stipulate a geometrical design for
a component, e.g. for an integrated circuit arrangement
or for another electronic component.

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The design data are, by way of example, grid data,
which stipulate individual pixels in a grid, or vector
data, which stipulate the design using vectors of
particular length and particular direction. In the
15 simplest case, the design is two-dimensional, e.g. in
the case of a design for a position for an integrated
circuit. A three-dimensional design is used, by way of
example, to stipulate the relationship between various
positions. The geometric design stipulates the external
20 shape of elements of the component, e.g. the outline of
an interconnect or the shape of a contact-hole
interconnect region.

It is an object of the invention to specify a simple
25 method for altering design data which is particularly
suitable for optimizing a design. The intention is also
to specify associated units.

The object relating to the method is achieved by the
30 method steps specified in patent claim 1. Developments
are specified in the subclaims.

The inventive method involves the automatic performance
of a plurality of cycles of the following method steps:
35 -   the design data are used to produce altered design
        data which are stored and stipulate a geometrical
        design which is altered locally in comparison with
        the geometrical design of the design data.
-      The altered design data are used to ascertain an

assessment criterion for the altered design.

- Next, the assessment criterion for the altered design is compared with an assessment criterion for the design which is to be altered.

5 - The unaltered design data are retained or replaced with the altered design data depending on the comparison result.

- In the next cycle, the altered design data are used as design data which are to be altered. The

10 assessment criterion calculated for the altered design data is used as assessment criterion for the design which is to be altered.

The inventive method means that the optimization of a

15 design, which has been performed predominantly manually to date, can be performed automatically. The automatic assessment of the designs within the context of optimization makes it possible to achieve automatic optimization in a simple manner.

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The local alteration essentially retains advantages of the design which have been achieved to date. Hence, those parts of the design which are situated outside of the local region are not altered during a cycle. The

25 parts which are situated within a region which is to be altered locally can be altered such that only comparatively moderate changes are made in each cycle.

The assessment criteria are dependent on the type of

30 component and the specific structure of the component. A single assessment criterion can be taken into account or an overall assessment criterion, which includes a plurality of assessment criteria which may also assess demands which conflict with one another.

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In the simplest case, the comparison of the assessment criteria is the formation of a difference, for example.

Other comparison methods may also be used, however.

Suitable rules are prescribed for retaining or for replacing the unaltered design data. These rules are
5   either deterministic or dependent on a random variable. Taking random variables into account provides the option of also accepting small losses during a cycle so as ultimately to improve the overall design to an extent which it would not be possible to achieve if
10 every cycle were also required to produce an improvement.

In one development of the inventive method, a region for the local alteration and the size of this region
15 are ascertained or prescribed without using a random function. Alternatively, the region and its size may also be ascertained using a random function, however. Through a suitable choice of method for ascertaining the region and its size, it is possible to reduce the
20 number of cycles needed for a particular improvement on the basis of the design which is to be improved.

In a subsequent development, a region for the local alteration and the size of this region are chosen on
25 the basis of an even distribution. This measure ensures that all regions of the design are included in the method to the same extent. Alternatively, the region or its size is selected by favoring regions or sizes which particularly impair the alteration of the assessment
30 criterion toward the aim of the method. If the assessment criterion is intended to be reduced in the course of the method, for example, then regions in which the assessment criterion is particularly high are favored. This measure also results in the number of
35 cycles required for a particular improvement being reduced.

In another development of the method for altering
design data, a region which has a square area, for
example, is selected for producing the altered design
data in the design stipulated by the design data which
5   are to be altered. This is followed by ascertainment of
the design data which relate to the design in the
selected regions. The ascertained design data are
altered on the basis of a prescribed function which
brings about a geometrical alteration of the design in
10   the selected region. In this way, the design data can
be altered in a simple manner.

The geometrical alteration can be made using simple
image processing methods, for example using filter
15   functions or using simple geometrical functions, such
as relocation, mirror imaging, rotation, expansion or
contraction. A simple geometrical alteration also
involves the design of the selected region being
replaced with the design of a geometrically similar
20   region at another location of the design which is to be
altered or with prescribed design parts which are
similar to the selected design part. The geometrical
alteration is not limited to the size of the design
which is to be altered. If it is also permissible to
25   increase the size of the total area, for example, then
the overall assessment criterion can nevertheless be
improved in many cases.

If, in one development, the stipulation for the
30   geometrical alteration is ascertained using a random
function, then no complicated rules for altering the
design need to be prescribed. By testing and
subsequently assessing the alteration, improvements can
be obtained in a simple manner.
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Suitable assessment criteria for electronic components
are the following assessment criteria, in particular:

- the critical area for short circuits,
- the critical area for interruptions,
- the number of corners or the number of edges in the design,
5 - the current-carrying capacity,
- coupling capacitances,
- the overlap for elements, and
- the total area of the design.

10 The critical areas are ascertained, by way of example, assuming circular defects in a prescribed size distribution. The size distribution is chosen such that defects which arise during the production of the component are simulated in the best possible manner.

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In one refinement, a plurality of designs of vertically arranged interconnect planes are simultaneously processed in line with the inventive method. In this way, the designs can be optimized particularly well, 20 for example in terms of the coupling capacitances or the overlaps between interconnects.

In a subsequent development, the assessment criterion is an overall assessment criterion which is ascertained 25 from at least two different assessment criteria. In a subsequent development, weighting factors are prescribed which are used when the overall assessment criterion is ascertained from the individual assessment criteria. This measure makes it possible to take 30 various assessment criteria into account to different degrees when carrying out the method. It also provides the option for particular assessment criteria to have a great influence on the alterations at the start of performance of the method, said influence then 35 subsiding in the course of the method in favor of the influence of assessment criteria with a small weighting factor. The weighting is performed in a linear fashion

or else on the basis of a nonlinear function.

In a subsequent development, the decision about the replacement of the unaltered result data is made on the basis of a random function. This measure allows not only an alteration which immediately must result in an improvement to the design to be carried out in a cycle. It also permits alterations to be accepted, on the basis of a particular probability, which result in no or only in insignificant impairment of the assessment criterion.

In a subsequent development, the dependency of the decision for or against acceptance of the random function is reduced on the basis of the number of cycles. This means that at the start of the method the acceptance of partial designs which result in an impairment, for example, is also permitted more frequently than at the end of the method. Such methods are also referred to as simulated annealing.

In another development of the inventive method, the designs have a grid dimension chosen for them which is equal to the width of a mask writing beam which is used for transferring the design onto a lithographic mask, e.g. onto a photomask. The designs produced using the method can thus easily be transferred onto the photomask without additional measures. In the case of one alternative, however, the designs have a grid dimension chosen for them which is less than the width of the mask writing beam. Such a procedure also sometimes results in masks which are very well suited to exposure.

The invention also relates to a data processing installation and a program which are suitable for carrying out the inventive method or one of its

developments. The aforementioned technical effects thus also apply to the data processing installation and the program.

5   Suitable components whose design is improved using the inventive method are, in particular:
     -     an integrated circuit arrangement, particularly a subcircuit which occurs in larger circuit arrangements very often, e.g. more than one
10   hundred times or even more than one thousand times. This relates to the circuit of a memory cell, of a contact-hole region or of a basic logic function, e.g. of an OR gate or of a NAND gate,
     -     a display, particularly a flat screen,
15   -   a sensor,
     -     a micromechanical component,
     -     a printed circuit board, and
     -     an electrical or electronic component on a film basis.
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Components from other technical regions are also optimized using the inventive method, however.

Exemplary embodiments of the invention are explained
25   below with reference to the appended drawings, in which:

figures 1A to 1C
             show the optimization of a design based on a
30   first exemplary embodiment,

figure 2   shows the result of optimization based on a second exemplary embodiment,

35   figure 3   shows method steps for optimizing a design,

figure 4   shows the profile of an assessment function

for the current density in an interconnect,

figure 5   shows the profile of an assessment function
            for an overlap between an interconnect and a
            contact hole, and

figure 6   shows functional units in an electronic
            circuit for optimizing the design.

Figure 1A shows a design 10 for a part of an integrated
circuit arrangement. The design 10 contains the outline
12 of an unbranched interconnect and the outline 14 of
an interconnect branched in a T shape. The outlines 12
and 14 are shown in a coordinate system 16 which has an
x-axis 18 for showing a grid dimension in the x-
direction and a y-axis 20 for showing a grid dimension
in the y-direction. The design 10 has the size of
twenty grid points in the x-direction and of sixteen
grid points in the y-direction.

The outline 12 is shown in the design 10 by three edge
lines 22, 24 and 26, which run from a terminal point T1
to a terminal point T2, and by three edge lines 28, 30
and 32, which run from a terminal point T3 to T4. The
outline 14 is shown by three edge lines 34, 36 and 38,
which run from a terminal point T5 to a terminal point
T6, by four edge lines 40 to 46, which run from a
terminal point T7 to a terminal point T8, and by two
edge lines 48, 50, which run from a terminal point T9
to a terminal point T10. Ten corner points 52 to 70 are
respectively located at the point of contact between
two edge lines 22 to 50 in various directions. The edge
lines 22 to 50 are located either in the x-direction,
in the y-direction or at an angle of 45 degrees or
135 degrees to the x-axis 20.

The terminal points T1 and T2 represent a left-hand

connection on the unbranched interconnect shown by the outline 12. The terminal points T2 and T4 represent a right-hand connection on the unbranched interconnect.

5   The terminal points T5 and T7 represent a left-hand connection on the branched interconnect shown by the outline 14. The terminal points T6 and T10 represent a left-hand connection on the branched interconnect. The terminal points T8 and T9 represent a bottom connection
10 on the interconnect, with the directions referring to the design 10 as is shown in figure 1B.

The position of the terminal points T1 to T10 is firmly prescribed in the exemplary embodiment. This means that
15 during optimization of the design 10 the outlines 12 and 14 may be altered only within the region situated between the terminal points T1 to T10. The position of the terminal points T1 to T6 is firm, on the other hand.
20

Figure 1B shows a design 10a with relocation in a relocation region 100. The relocation arises when carrying out the optimization method explained below with reference to figure 3 in a first cycle. The
25 relocation region 100 is located in the top left-hand corner of the design 10 and has a length of seven grid points in the x-direction and a length of six grid points in the y-direction 20. The relocation region 100 contains the terminal points T1 and T3. A right-hand
30 boundary line 102 for the region 100 intersects the edge line 22 at an auxiliary point HT1 which is situated approximately in the center of the edge line 22. The right-hand boundary line 102 intersects the edge line 28, situated parallel to the edge line 22, at
35 an auxiliary point HT2 which is situated somewhat to the right of the center point of the edge line 28. Within the region 100, the edge lines 22 and 28 are

shown by dashed lines 104 and 106, since the edge lines
22 and 28 are relocated there in the first optimization
cycle in a randomly chosen direction and by a randomly
chosen number of grid points.

5

In the exemplary embodiment, it is assumed that in the
first method step the randomly chosen direction is a
direction which is the opposite of the y-direction. The
randomly chosen grid dimension has the value one, cf.
10   relocation arrow 108. On account of the relocation in
the relocation region 100, the dashed line 104 is
relocated by one grid point counter to the y-direction
20. The terminal point T1 and the auxiliary point HT1
remain unchanged at their original position, however.
15   The dashed line 104 produces a new edge line 110 which
is parallel to the dashed line 104 and ends at corner
points E1 and E2. The corner points E1 and E2 are then
connected by inclined edge lines 112 and 114 to the
terminal point T1 and to the auxiliary point HT1,
20   respectively, in accordance with the grid, i.e. while
retaining neighborhood relations.

The dashed line 106 is relocated in the same way. In
this case, the result is an edge line 116 which is
25   relocated one grid point downward parallel to the
dashed line 106 and is situated between two corner
points E3 and E4. Next, an edge line 118 is produced
which runs from the terminal point T3 to the corner
point E3. An edge line 120 is produced such that it
30   runs from the terminal point E4 to the auxiliary point
HT2.

The relocation operation indicated by means of the
relocation arrow 108 relocated the outline 12 of the
35   unbranched interconnect one grid point downward within
the region 100 without altering the width of the
outline 12 in the process. The relocation was executed

such that both terminal points T1 to T10 and auxiliary
points HT1 and HT2, at which edge lines 22 to 50 in the
design 10 intersect boundary lines 102 for the
relocation region 100, remain unaltered in their
5   position. Starting from the altered design 10a, the
steps explained below with reference to figure 3 for
assessing the altered design 10a are carried out. If it
is established that an improvement has been made to the
design 10, the design 10 is always accepted for the
10   rest of the optimization method with the alteration
produced in the region 100. If no improvement has been
made, on the other hand, then the rest of the
optimization is usually performed without the
alteration produced in the relocation region 100, i.e.
15   again starting from the design 10.

In a subsequent cycle of the optimization method, a
relocation region is again selected randomly, e.g. a
relocation region 122 which is situated further in the
20   center of the design 10 or 10a than the relocation
region 100. The relocation region 122 is also somewhat
larger than the relocation region 100. In the
relocation region 122, edge lines are again relocated
in a randomly chosen direction and by a randomly chosen
25   number of grid points.

Figure 1C shows a design 10b which has been produced
from the design 10 using the optimization method which
is explained below with reference to figure 3. During
30   optimization, short circuits were weighted twice as
highly as interruptions. The outlines 12 and 14 of the
interconnects have changed, and outlines 12b and 14b
have been produced. Four edge lines 150 to 156 are now
situated between the terminal points T1 and T2. There
35   are now just two edge lines 156 and 158 between the
terminal points T3 and T4.

The outline 14b for the branched interconnect is formed by two edge lines 160 and 162 between the terminal points T5 and T6, by three edge lines 164, 166 and 168 between the terminal points T7 and T8 and by two edge
5   lines 170 and 172 between the terminal points T9 and T10. In the design 10b, there are now just eight corner points 180 to 194. This simplifies mask production.

Figure 2 shows a design 10c which has been produced
10   from the design 10 when carrying out an optimization method in line with figure 3, with short circuits having been weighted ten times as highly as interruptions. An outline 12c for the unbranched interconnect is now shown by four edge lines 200 to 206
15   between the terminal points T1 and T2 and by three edge lines 208, 210 and 212 between the terminal points T3 and T4. An outline 14c for the branched interconnect is shown by three edge lines 214, 216, 218 between the terminal points T5 and T6, by three edge lines 220, 222
20   and 224 between the terminal points T7 and T8 and by three edge lines 226, 228 and 230 between the terminal points T9 and T10. There are eleven corner points 250 to 270 in the design 10c. It can easily be seen that the interspaces between the outlines 12c, 14c of the
25   interconnects and the interspaces between the interconnects have been widened automatically at the cost of the width of the outlines 12c, 14c and the width of the interconnects, in order to reduce the occurrence of short circuits. The number of corner
30   points has increased just by one corner point, which means that the mask production on the basis of the design 10c is only insignificantly more complex in comparison with the design 10.

35   Figure 3 shows method steps for optimizing a design for producing an integrated circuit arrangement, for example for optimizing the design 10 shown in figure 1.

The method starts in a method step 300 with the
stipulation of a plurality of parameters. By way of
example, a step count variable n is set to the value
one. A constant for indicating the number of steps N is
5   set to the value one thousand, for example. An overall
assessment criterion GBM is set to a very small value,
e.g. to the value minus ten thousand. The value of this
overall assessment criterion GBM is intended to become
as large as possible in the course of the method,
10 because its value is in an inversely proportional
relationship with the level of the costs which are to
be expected. In addition, weighting factors W1 equal to
two and W2 equal to one are prescribed which indicate
the weighting of an assessment criterion for short
15 circuits and of an assessment criterion for
interruptions. The stipulation of the values in method
step 300 is dependent on the type of design which is to
be optimized. In addition, the stipulation of the
values is determined by the objective of the
20 optimization, cf. the explanations relating to
figures 1C and 2, for example.

In a method step 302, a design to be optimized is
prescribed, e.g. the design 10 by the data contained in
25 a GDS2 file. The design 10 is the result of a manual
design process or the result of earlier automatic
optimization which is now intended to be reoptimized on
the basis of different criteria, for example. The
prescribed design is stored as the best design to date,
30 i.e. as a "best-ever" design.

In a subsequent method step 304, the data processing
installation carrying out the method automatically
selects a relocation region within the design, e.g. the
35 relocation region 100 or the relocation region 122.
This takes account of a random function, for example.
In addition, in method step 304 the size of the

relocation region is prescribed, for example likewise taking into account a random function within a prescribed size range.

5   Next, an offset direction and an offset criterion are chosen in a method step 306, with random functions again being taken into account, for example. In a subsequent method step 308, parts of the design to be optimized within the relocation region 100, 122 are
10   then offset on the basis of the values determined in method step 306. The offsetting operation has been explained above for the relocation region 100 with reference to figure 1B.

15   In a method step 310, the altered design, possibly only taking into account the relocation region 100 plus a suitable boundary region, is taken as a basis for calculating an assessment criterion BM1 for the occurrence of short circuits and an assessment
20   criterion BM2 for the occurrence of interruptions. In this case, "critical areas" are taken into account, which apply to defects of a prescribed size.

In a method step 312, an overall assessment criterion
25   GBM for the method step currently being carried out is calculated. In this case, the assessment criteria BM1, BM2 and the weighting factors W1 and W2 are used. By way of example, the following formula applies:

30            $GBM(n) = W1 \cdot BM1 + W2 \cdot BM2.$

In a method step 314, the overall assessment criterion GBM(n) calculated in method step 312 is compared with the overall assessment criterion GBM(n-1) calculated
35   for the preceding method cycle or, in the case of the first cycle, with the overall assessment criterion GBM prescribed in method step 300. If it is established

that the value of the overall assessment criterion has increased in the current cycle, then method step 314 is followed immediately by a method step 316 in which the alteration to the design is accepted. In addition, the
5   value calculated in method step 312 for the overall assessment criterion is recorded as the overall assessment criterion which is valid for performing further cycles when the alteration is accepted.

10   If, on the other hand, it is established in method step 314 that the overall assessment criterion GBM has not increased, i.e. the overall assessment criterion GBM has remained unchanged or has decreased in size, then method step 314 is followed immediately by a method
15   step 318.

In method step 318, a prescribed method taking into account a random function is used to ascertain whether the alteration to the design is intended to be accepted
20   for the rest of the method or rejected. A function used in this context is the following function, for example in the case of the "metropolis method":

$$p = \exp(-\Delta GBM/T),$$

where p denotes the probability of acceptance, exp
25   denotes the exponential function, ΔGBM denotes the difference between GBM(n-1) and GBM(n), and T denotes a parameter which can be equated to a simulation temperature.

30   The parameter T can be altered in the course of the method, for example on the basis of one of the two following formulae:

$$T(n) = T0/(1+\ln n),$$
$$T(n) = T0/(1+n),$$

35

where T0 denotes a constant which can be physically equated to a high temperature, n denotes the step count

variable and ln denotes the natural logarithm.

Using the exponential function, the reduction in the
overall assessment criterion GBM (which is brought
5   about by the alteration) is taken as a basis for
determining a value p which indicates a probability
with which the alteration will be accepted. A random
number generator is used to generate a number which is
randomly in a range between zero and one. If the random
10   value generated using the random number generator is
smaller than the value determined using the function,
then there is acceptance. If, on the other hand, the
random value is larger than or equal to the value taken
from the function, then the alteration to the design is
15   rejected. If the design is accepted, then the overall
assessment criterion calculated in method step 312 is
also accepted for the rest of the method. If the
alteration is rejected, on the other hand, then the
overall assessment criterion calculated in method step
20   312 is likewise rejected as invalid.

Both method step 316 and method step 318 are followed
immediately by a method step 319, in which a check is
carried out to determine whether the current design has
25   a smaller overall assessment criterion than the best
design. If the current design's overall assessment
criterion is smaller than the best design's overall
assessment criterion, then the current design is
accepted as the best design. If, on the other hand, the
30   current design's overall assessment criterion is not
smaller than the best design's overall assessment
criterion, then the current design is not accepted as
the best design, which means that the best design is
not altered.
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In a method step 320 which follows method step 319, a
check is carried out to determine whether the value of

the step count variable n has already reached the value
of the prescribed number of steps N. If this is not yet
the case, then method step 320 is followed immediately
by a method step 322. In method step 322, the value of
5   the step count variable n is increased by the value
one. In addition, the selectivity of the function
explained below with reference to figure 6 is increased
continuously or on the basis of another suitable
method. This also increases the selectivity during the
10   random selection. The probability of impairments in the
design being accepted falls as the number of method
cycles increases.

When method step 322 has been carried out, the method
15   is continued in method step 304 with a new cycle. The
method is now in a method loop comprising method steps
304 to 322, said loop being executed until method step
320 establishes that the step count variable n has
reached the value of the number of steps N. In this
20   case, method step 320 is followed immediately by a
method step 324, in which the optimization method is
terminated. The design stored as the best design is
output as the result, e.g. in a file.

25   Alternatively or in addition to the abort option just
explained, the method may also be terminated if the
change in the overall assessment criterion GBM
undershoots a prescribed limit over k cycles, where k
is a natural number greater than two, e.g. 100.
30   Particularly in the case of larger k values, it must be
assumed that a "stable" solution has been achieved.

The optimization method explained with reference to
figure 3 is a type of simulated annealing which ensures
35   that maximization of the overall assessment criterion
GBM finds not only a local maximum but also the global
maximum. This means that actually the optimum design

and not just a suboptimum design is ascertained
depending on the stipulations in method step 300.

Figure 4 shows the profile of an assessment function
5   400 which is used during another exemplary embodiment
additionally for ascertaining an assessment criterion
BMD to assess the current density D in the changed
design. The assessment function 400 is shown in a
coordinate system 402 which has an x-axis 404 for
10   showing the values of the current density D and a y-
axis 406 for showing the values of the assessment
criterion BMD. In the range of very small current
densities D up to a maximum current density Dmax, the
value of the assessment criterion MD drops from very
15   large positive values to a small positive value in line
with a falling exponential function. Exceeding the
maximum current density Dmax is "punished" by the
choice of a very large negative value for the
assessment criterion BMD, because a design rule has
20   been infringed. In method step 310, the current density
D is calculated for a structure which is intended to be
produced using the changed design. After that, the
associated value of the assessment criterion D is
ascertained for the calculated current density D using
25   the assessment function 400 and is weighted with a
weighting factor W3 when calculating the overall
assessment criterion GBM.

Figure 5 shows the profile of an assessment function
30   450 for the overlap U between an interconnect and a
contact hole situated underneath. The assessment
function 450 is shown in a coordinate system 452 which
has an x-axis 454 for showing the value of the overlap
U and a y-axis 456 for showing the values of an
35   assessment criterion BMU for assessing the overlap. The
values of the overlap U may also become negative if no
overlap or a distance which is transverse with respect

to the actual direction of overlap arises. The assessment criterion BMU has a large negative value for negative values of the overlap U. For small overlaps U, the assessment criterion BMU has a small positive
5   value. As the overlap U rises, the assessment function 450 then increases in line with an exponential function.

In a subsequent exemplary embodiment, the assessment
10   criterion BMU is used to calculate the overall assessment criterion GBM in method step 310. A weighting factor W4 is used to weight the assessment criterion BMU.

15   Figure 6 shows functional units in an electronic circuit 550 which is used to optimize the design 10 and hence to carry out the method steps explained with reference to figure 3. In line with one exemplary embodiment, the circuit 550 does not contain a
20   processor, but rather only logic circuits.

The design 10 is stored in a memory unit 552. A design change unit 554 is used to change the design in a relocation region 106, 122. The design change unit 554
25   uses a bus system 556 to access the memory unit 552 bidirectionally. Assessment criterion calculation units 558 to 562 are used to calculate assessment criteria BM1 to BMm, where m is a natural number for denoting the last assessment criterion. The assessment criterion
30   calculation units 558 to 562 read the data for the altered design, e.g. 10a, which are stored in the memory 552 via a bus system 564.

The overall assessment criterion GBM is calculated in
35   an overall assessment criterion calculation unit 566 whose input side is connected to outputs of the assessment criterion calculation units 558 to 562 via

lines 568. The calculation unit 566 performs the calculation of the overall assessment criterion which was explained in figure 3 for method step 312. The calculation unit 566 outputs the calculated overall
5   assessment criterion GBM to a control unit 572, which is used for controlling the optimization method, via a line 570.

The control unit 572 controls the other units in the
10   circuit 550, cf. control line 574 for controlling the design change unit 554, for example. The control line 574 is used to prescribe, by way of example, the position of a relocation region, e.g. 100, 122, the direction, e.g. 108, of the relocation, and the
15   relocation criterion.

In another exemplary embodiment, the circuit 550 also contains a processor 600 which executes commands in a program which is stored in the memory unit 552. The
20   processor 600 accesses the memory unit 552 via a bus system 602. When using the processor 600, the functions of the design change unit 554, of the assessment criterion calculation units 558 to 562, of the GBM calculation unit 566 and of the control unit 572 are
25   provided when the commands in the program are executed. Instead of the lines 568, 570 and 574, transfers of parameters to memory cells are used for data interchange.

30   While method steps 316 and 318 apply to the "metropolis method" of simulated annealing, in a subsequent exemplary embodiment both method step 316 and method step 318 involve a random decision being made on the basis of the difference between the overall assessment
35   criteria. A suitable function for determining the comparison value for the random value is sigmoid functions, for example, whose gradient is dependent on

the value of the temperature T.

In another exemplary embodiment, instead of the "simulated annealing" optimization method a different optimization method is used:

- by way of example, the relocation is ascertained which results in the greatest improvement to the overall assessment criterion GBM in each method cycle. Such a method is known as a method for calculating the greatest ascent or descent (steepest-descent method),
- or a "genetic algorithm", in which the design region from another design is accepted on the basis of prescribed criteria, or
- a combination of said optimization methods.

In a further exemplary embodiment, the overall assessment criterion is reduced in size in order to improve the design. For this, it is necessary to choose the assessment functions such that improvements to the design result in smaller assessment criteria.